

Connections Between Theory of Mind and Pronoun Competence:  
Typically-developing Children and Children with Autism Spectrum Disorders

A Senior Honors Thesis

Presented in Partial Fulfillment of the Requirements for graduation with distinction in  
Spanish and Portuguese in the undergraduate colleges of The Ohio State University

by

Valerie Niemiec

The Ohio State University  
April 2006

Project Advisor: Dr. John Grinstead, Department of Spanish and Portuguese

## **Acknowledgments**

I would like to thank my advisors on this senior thesis, Dr. John Grinstead, Dr. Laura Wagner, and Dr. Paula Rabidoux, for their unfailing insight and advice throughout the past year. I have grown personally and professionally as a result of their intellectual and moral support. I would also like to thank the Developmental Language and Cognition Lab run by Dr. Laura Wagner and the Nisonger Center for their support of this project. In addition, I would like to thank my amazing family and friends for their constant encouragement and support in all aspects of my life.

This project was presented at the 2007 SRCD Biennial Meeting, for which travel expenses were funded by the USG Academic Enrichment Grant Program.

## Abstract

Pronouns are a complex part of our everyday language with both grammatical and pragmatic dimensions. Pronouns have long been a subject of research; however there are few comprehensive examinations of their grammatical aspects (gender and case), pragmatic aspects (interlocutor specificity and discourse continuity), and their possible cognitive correlations (theory of mind). This study examines all these dimensions with the purpose of providing a clearer understanding of how linguistic and non-linguistic cognition interact.

The two groups participating in the study were typically-developing children and children with Autism Spectrum Disorders (ASD). Research has shown that ASDs hinder the cognitive ability of theory of mind, which may affect pronoun use. Looking at the different dimensions of pronouns in this specific population will help address whether a difficulty with theory of mind also encumbers competence in pronoun use. The applied aims of this study include a further understanding of the linguistic bases that may relate to theory of mind operational problems, as well as finding linguistic features salient to pragmatic language use. The increased knowledge of linguistic features impacted by an ASD could help provide more effective future treatments.

The study consisted of five tasks that examined different components of pronoun use as well as theory of mind. The gender task asked children to identify characters based solely on gendered pronouns (*he* and *she*). The case task was a grammaticality judgment task that asked children to identify nominative and accusative pronoun case errors (*him is on the rock*). The discourse task (adapted from Song & Fisher 2005) asked children to track a referent through a story using pronouns. The interlocutor task was a

production task and asked children to identify a referent to an interlocutor new to the discourse situation. Finally, an unseen-displacement task was used to assess theory of mind.

It was predicted that grammatical properties of pronouns would be acquired before pragmatic dimensions, and that theory of mind ability would correlate with the pragmatic but not the grammatical tasks. The findings showed that children performed significantly better on the grammatical gender task than the pragmatic tasks. They also illustrated a slight correlation between theory of mind task success and the use of an adult-like noun phrase to introduce an unfamiliar referent. The ASD children passed the theory of mind task and performed well on the structured language tasks.

Future research will look at more typically developing children at the cusp of theory of mind ability to determine the significance of the slight correlation between theory of mind and the pragmatic interlocutor. In addition, younger participants with ASD will be studied to allow for a better comparison between pronoun use and theory of mind ability in children with an ASD. In order to develop more efficient and effective treatment for the language problems that often accompany an autism spectrum disorder, it is necessary to continue looking at the possible affects of theory of mind on language, including the search for other syntactical/grammatical tasks that may be related to theory of mind ability.

## Table of Contents

Abstract.....	2
Acknowledgments.....	3
Table of Contents.....	5
Chapter 1: Introduction and Literature Review.....	6
Chapter 2: Experiment 1-Typically-Developing Children.....	13
Section 2.1: Method.....	13
Section 2.2: Results and Discussion.....	17
Section 2.3: Summary and Conclusion.....	23
Chapter 3: Experiment 2- Children with Autism Spectrum Disorders.....	25
Section 3.1- Method.....	25
Section 3.2- Results and Discussion.....	26
Section 3.3- Summary and Conclusion.....	28
Chapter 4: References.....	31
Chapter 5: List of Tables.....	33

## Chapter 1: Introduction and Literature Review

This study has both applied and basic scientific objectives. Pronouns are a complex part of our everyday language with both grammatical and pragmatic dimensions. Pronouns in general have long been a subject of linguistic research; however, there have been few comprehensive examinations of the grammatical aspects of pronouns (gender and case), as well as the pragmatic aspects (interlocutor specificity and discourse continuity), and their possible cognitive correlations (theory of mind). These five components (gender, case, interlocutor specificity, discourse continuity, and theory of mind) together play a large role in how we use pronouns in everyday communication. A concrete theory of mind enables a person to understand that one's own perspective may be distinct from that of one's interlocutor. Theory of mind was examined in order to see if there is a relation between a child's pragmatic ability to use pronouns correctly and the ability to see another's perspective as distinct from one's own. The examination of these five dimensions of pronoun use may give us a clearer understanding of how linguistic and non-linguistic cognition interact.

A specific population of interest for this study is children with Autism Spectrum Disorders (ASDs). A great deal of research has shown that ASDs negatively impact theory of mind ability, a cognitive ability that may affect the global use of pronouns. Looking at the different dimensions of pronouns in this specific population will help begin to answer whether a difficulty with theory of mind also encumbers the ability to reach more mature levels of competence in pronoun use. In addition to furthering the understanding of how grammar and theory of mind correlate, this study may also help

further the clinical understanding of how an Autism Spectrum Disorder may affect the development of a specific linguistic system.

The applied aims of this study include a further understanding of the linguistic bases that may relate to theory of mind operational problems, as well as finding linguistic features salient to pragmatic language use. This information would be beneficial in the development of more focused screenings for pragmatic abilities by identifying related linguistic constructions. The increased knowledge of linguistic features impacted by an ASD could help provide more effective and efficient treatment in the future.

#### *Familiarity Presupposition of Pronouns*

Pronouns have been the focus of a great deal of linguistic research. For concreteness, I will assume the framework of Roberts's 2005 paper. According to Roberts, one aspect of pronoun use in conversation is the "familiarity presupposition." This signifies that the use of a pronoun presupposes that the interlocutors already know a discourse referent that corresponds to that pronoun (Roberts, 2005). For example, it would not be acceptable for an adult speaker to say, "He really likes ice cream" without any referent known to the interlocutors. Whether a child possesses knowledge of this familiarity presupposition is examined in the interlocutor task of this experiment by measuring a child's use of a pronoun, a definite noun phrase, or an indefinite noun phrase with a new interlocutor.

#### *Discourse Salience of Pronouns*

Another aspect of pronouns Roberts makes reference to is discourse salience of a pronoun. When a pronoun is used in discourse, it takes on the referent that is maximally

salient in the anteceding discourse. Roberts states that this is why pronouns do not possess a great deal of uniqueness. They do not need to possess a great deal of uniqueness if the possible referent in the anteceding discourse is strongly restricted. The discourse salience of pronouns is examined in this experiment using an adapted version of Song and Fisher (2005) that looked at children's ability to track a referent throughout discourse.

Song and Fisher measured whether or not children are sensitive to the same discourse prominence in pronoun interpretation that adults demonstrate. When adults are presented with a pronoun in discourse, they must infer that a gender and number matched referent must have already been presented in the discourse. This is known as *The Discourse Representation Theory* and was proposed by Kamp and Reyle in 1993. Song and Fisher used a preferential-looking task to determine whether 3-year-old children would interpret a subject pronoun by matching the pronoun to a previous referent in subject position. In this task, the children were presented with a narrative and corresponding pictures. The narratives contained two characters, one of which was continually placed in subject position. The final sentence of the narrative asked the children a question using a pronoun, such as "What does **he** have?". Preferential-looking measurements were then used to see which character the children demonstrated a preference toward. The study found that with preferential looking, the continued-subject preference was held by the 3-year olds. The discourse task in this experiment adapts the Song and Fisher task by measuring whether children can explicitly choose which character is represented by the pronoun, rather than using preferential-looking.



### *Morphological Case*

A third feature necessary for correct pronoun use is the mastery of morphological case, a feature investigated by Wexler, Schütze, and Rice in children with Specific Language Impairment (SLI). In the English language, case provides the distinction between nominative, accusative, and genitive forms of pronouns. This distinction is guided by the structural relations of syntax, such as whether the pronoun is being used as a subject or an object (Wexler, Schütze, and Rice, 1998). The 1998 experiment found that common case errors in children result from the lack of certain pairs of contrasting case forms, for example “her vs. she.” This may result in the child using only the mastered “her” for all instances calling for third person singular feminine (or the occurrence of “she” in all occurrences). If the child has partial mastery of both of these forms, however, they make a different set of errors in instances that call for nominative case. Wexler, Schütze and Rice argue that children tend to use the correct nominative form when there is verb agreement with the pronoun, but more often use a non-nominative form when the verb lacks agreement or is uninflected. For example, when producing a sentence with a subject pronoun and a verb, children would be more likely to use either the nominative or the accusative pronoun as a subject (he or him) if given no agreement reference in the verb, such as kiss-. However, if verb agreement is present, such as kisses, children are much less likely to use the incorrect accusative pronoun as the subject (Wexler, Schütze, and Rice, 1998).

It is important to note that the ideas presented by Wexler, Schütze, and Rice are not entirely accepted in the field. One challenge comes from the Charest and Leonard 2004 article, in which they show that the Agreement/Tense Omission Model presented

previously may not account for all errors of nominative case because children in their study did not always use the correct subject pronoun, even in the presence of verb agreement (ex. Her runs.). The present study uses a grammaticality judgment task to test the children's receptive grammatical competence for pronoun case in transitive and intransitive sentences. It examines the children's ability to judge the correct case of third person pronouns in sentences that specifically call for either the nominative or the accusative form of the pronoun. This will allow the analysis of certain case forms that may contain errors in children, as well as the relation of overall mastery of case to the other components of pronoun usage.

### *Theory of Mind*

A cognitive ability that may affect this overall pronoun usage is Theory of Mind: the ability to attribute mental states to oneself and others (Wimmer and Perner, 1983). The experiment first conducted by Wimmer and Perner in 1983 measured whether or not children possessed an explicit and definite representation of the belief of another person. They found that most 3-4 year old children were not able to represent a person's absence of knowledge correctly, whereas the majority of 4-5 year olds were successful in doing so. This type of false belief task is known as first-order theory of mind task because it looks at the child's comprehension of "A thinks X". There are also second-order tasks that go one step further into theory of mind by looking for the child's comprehension of "A thinks B thinks X" (Rowe, et al, 2001). The present study uses a first-order false belief tasks with participants ranging in ages from 3;7 to 4;2. This allowed us to examine a variety of theory of mind abilities and thus determine how the theory of mind ability may impact pronoun use.

One population that many studies have found to have theory of mind deficits is children with autism. Children with autism tended to perform significantly less well on theory of mind tasks, such as the false belief task presented previously, than matched comparison children (Baron-Cohen, 2000). Past research has shown that children with autism perform poorly in theory of mind tasks that focus on the previously mentioned changes that take place around age four in normally developing children. Conversely, there has also been a longitudinal study showing that “children with autism do show significant developmental changes in theory of mind abilities over the course of one year” (Steele, Joseph, and Tager-Flusberg, 2003). The improvements shown by children in the study suggested that they had acquired some mental state concepts during this period, and thus illustrated that a pre-adolescent child with autism may indeed demonstrate developmental changes in theory of mind abilities.

#### *Autism Spectrum Disorders and Pronouns*

Children with autism have demonstrated a greater tendency for error in regard to pronoun use than their language-age matched typically developing peers (Baltaxe and D’angiola, 1996). The most common errors children with autism made in relation to first-person pronouns were errors of omission, whereas the most common third-person errors were non-identification errors (use of a pronoun without a clear referent). The use of a third person pronoun has an important role in topic maintenance and in differentiating old information from new information, aspects that could be impacted if a speaker struggles with an understanding of “speaker-hearer presuppositions” (Baltaxe and D’Angiola, 1996). The second experiment of this study focuses on the population of children with autism spectrum disorders (ASDs). Both studies look closely at the

components of third-person pronoun use along with theory of mind abilities to examine whether the tendency to commit a non-identification error may correlate with a deficiency in theory of mind ability as proposed by Baltaxe and D'Angiola.

## Chapter 2: Experiment 1- Typically-Developing Children

### Section 2.1: Method

#### Participants

Thirty-three children ranging in ages from 3;7 to 4;2 (18 girls and 15 boys) participated in the study. This experiment recruited children at the cusp of theory of mind ability with the aim of getting half the subjects to pass and half to fail an unseen-displacement task. Twenty-six of the children were able to complete all five sections of the study (those who were unable to complete all the sections were excluded from the data). Children who were unable to correctly answer a subset of the theory of mind task (the memory question) were analyzed separately, and are discussed below.

#### Procedures

The study consisted of five tasks that together examined four different components of pronominal use (gender, case, discourse continuity, and interlocutor specificity) as well as theory of mind. The gender task was a picture verification task examining the child's knowledge of the gender of pronouns. The children were presented with pictures of both a male and a female, each possessing a distinct object, and then asked either "What does she have?" or "What does he have?" to test their knowledge of gender. The children could respond by naming the specific object or by pointing to the object in the picture.

The case task was a grammaticality judgment task formed to examine the child's knowledge of pronominal case in the transitive subject, transitive object, and intransitive subject positions. Two puppets were used in this task to present the children with two sentences differing only in the pronoun case, only one of which was grammatically

correct (see Table 1.1 for examples). The children were then asked to select which puppet spoke correctly (“Tell me which one said it right.”) to demonstrate their receptive knowledge of appropriate case. Before beginning the trials in this task, the children were given four training questions with the identical format of grammaticality judgment, but using a grammatical aspect that should be mastered in a child of the tested age range. For example, in the first training trial, one puppet said, “The boy eats ice cream”, while the other said, “Boy the eats ice cream”. The child was then asked to determine which one said it right, exactly as the child would be asked in the case task. This task uses a format in which the child is asked to choose between two alternatives as opposed to having a child judge whether a single sentence is produced correctly or incorrectly. This type of task was chosen because it decreases the processing burden placed on the child in order to better evaluate solely their language processing abilities (Pratt & Grinstead, 2007). For example, if a child is asked to determine the correctness of one sentence, the child would need to produce a plausible alternative in his or her head. We chose to remove that extra processing burden in this task by explicitly providing the two option sentences, one correct and one incorrect. Pictures were also used in this task to illustrate the sentence for the child, thus showing that while only one sentence was grammatical; both sentences were valid in their description of the picture.

	Correct Response	Incorrect Response
<b>Intransitive Subject</b>	<b>He</b> is swinging.	<b>Him</b> is swinging.
<b>Transitive Subject</b>	<b>She</b> kisses him.	<b>Her</b> kisses him.
<b>Transitive Object</b>	He carries <b>her</b> .	He carries <b>she</b> .

Table 1.1- Examples sentences from the case task

The discourse task was a picture-selection task that measured how children tracked a referent through a narrative and was adapted from Song and Fisher (2005). The children were read a story with two characters and presented with the corresponding

pictures. One of the two characters was presented in the subject position throughout the story. In the story, both the characters were introduced in the same way (e.g., See the dog and the mouse). One character then became the subject while the other becomes the object (e.g., The mouse pets the dog. He likes the dog.). After two sentences possessing the same subject (one with a definite NP and one with a pronoun) were read, the child was asked the question, “What does he have?”. This design tested whether children were able to track a referent throughout the narrative and thus correctly identify the referent of a nominative pronoun.

The interlocutor task measured how a child would introduce a subject to a new interlocutor. Spontaneous speech was also recorded during this task to look at the child’s spontaneous pronoun use. To set up the task, the children played with a girl doll in a dollhouse with the experimenter. The experimenter discussed the doll’s actions with the child using a pronoun since they were both familiar with the subject (e.g., She went downstairs. She ate breakfast.). After the child was comfortable discussing the doll’s actions with the experimenter, the doll was removed from the house and a new interlocutor (a puppet) was introduced. Since the new interlocutor had no knowledge of the doll, this task showed whether a child would continue to use a pronoun to refer to the doll or if the child would consider the new interlocutor’s lack of knowledge and use a more appropriate noun phrase (either the definite “the girl” or the indefinite “a girl”). There are different degrees of listener familiarity presumed by each noun-phrase type. The adult-like response of the indefinite noun phrase, “a girl”, presumes the smallest amount of listener familiarity. Adults will also allow the use of a definite noun phrase (“the girl”) to introduce a new referent, but usually only with some form of deictic

reference (a spatial reference, e.g., pointing) or social/situational familiarity (e.g., The President of the United States). The children in the study would not be able to have a concrete deictic reference because “the girl” in question is not present when the new interlocutor is introduced. Lastly, the use of a pronoun (“she”) presumes the greatest amount of listener familiarity and is the least accepted introduction by adults in this situation.

The theory of mind task used was a first order unseen displacement task developed by Wimmer and Perner (1983). The task involved two buckets, a toy car, and a puppet. First, the children observed as a puppet hid the toy car before taking a nap. While the puppet took a nap, he was covered by a blanket which, as was explained to the children, prevented him from seeing or hearing what was going on around him. During the puppet’s nap, the child witnessed the experimenter moving the toy car between buckets. Following this, the puppet was woken from his nap and the child was told the puppet wanted to play with his car. The experimenter then asked the child where the puppet would look for the car. Finally, each child was asked a memory question to determine whether he or she knew the original location of the car. This allowed the experimenter to determine if the child simply forgot the original location and therefore determine if the child may have been guessing at the previous question (“Where will the puppet look for the car?”). If the child did not know the original location of the car, it would be impossible for the child to hypothesize where the puppet would look correctly unless the answer was simply a guess. The goal of this experiment was to determine whether the child could overcome their own knowledge in order to take the perspective of another.



It was predicted that the grammatical properties of pronouns (gender and case) would be acquired before the pragmatic dimensions (discourse salience and interlocutor specificity) because gender and case depend on mastery of a specific linguistic system while pragmatic ability depends on more complex skills, such as knowledge of an interlocutor's state of mind. The other prediction was that theory of mind ability would correlate with the pragmatic features of pronouns but not the grammatical ones because pragmatic skills require sensitivity to the knowledge states of one's interlocutor, which is also a skill required for the mastery of theory of mind abilities. The overall objective of this study was to determine to what degree theory of mind and the pragmatic ability implicated in pronoun use might correlate.

## Section 2.2: Results and Discussion

Statistical analysis did not yield significant results and therefore the results of the statistical analyses are not included in this report. Possible associations and future research implications are analyzed and discussed throughout the results and discussion sections of this paper.

### *Language Ability*

Overall, the children in the study performed extremely well on the gender task (94% correct overall) and were closer to average on the case task (63%) and the discourse task (54%). The score of the interlocutor task was given based on whether an indefinite noun phrase (score of 2.0), a definite noun phrase (score of 1.0), or a pronoun (score of 0) was used to introduce the subject to a new interlocutor. The most common introduction

used was the definite noun phrase (an overall average score of 0.81). See Table 1.2 for average scores on each language task.

	Average Score
<b>Gender Task</b>	94% correct
<b>Case Task</b>	63% correct
<b>Discourse Task</b>	54% correct
<b>Interlocutor Task</b>	0.81

Table 1.2- Overall Results on Language Tasks

### *Pronominal Case*

Given one grammatically correct sentence and one sentence with an ungrammatical pronoun, children were able to pick out the correct sentence with 63% accuracy overall. The children's ability to choose the grammatically correct sentence was slightly higher for the transitive sentences than the intransitive sentences. See Table 1.3 for overall results of the case task.

	Average Score
<b>Intransitive Subject</b>	55% correct
<b>Transitive Subject</b>	68% correct
<b>Transitive Object</b>	66% correct
<b>Total</b>	63% correct

Table 1.3: Components of Case Task Results

### *Theory of Mind*

Twenty-six children were able to answer the memory question subset of the theory of mind task. Of those twenty-six children, fourteen demonstrated the theory of mind ability necessary to pass the unseen-displacement task. Theory of mind passers had an average age of 4;0, while the failers averaged an age of 3;10. Eight females and six males passed the theory of mind task, while six females and six males failed the task. See Table 1.4 for detailed theory of mind results.

Theory of Mind	Average Age	Males	Females	Total
Pass	4;0	6	8	14
Fail	3;10	6	6	12

Table 1.4 - Theory of Mind results

### *Pronouns and Theory of Mind*

Children tended to perform equally on the gender and discourse tasks regardless of their theory of mind ability. There was a slight correlation between theory of mind ability and scores on the case and interlocutor tasks. Children who passed the theory of mind task had an average score of 69% on the case task, while those who failed theory of mind had an average of 55%. Refer to Table 1.5 for data on the relationship between theory of mind and the language tasks. Of the children who used an indefinite noun phrase in the interlocutor task, 80% passed the theory of mind task, whereas of the children who used a pronoun in the interlocutor task, only 40% passed the theory of mind task. Refer to Table 1.6 for data on the relationship between the interlocutor and theory of mind tasks.

Theory of Mind	Gender Average	Case Average	Discourse Average
Pass	95%	69%	50%
Fail	93%	55%	58%

Table 1.5- Language Tasks vs. Theory of Mind

Pronoun-type used	Subjects who fail ToM	Subjects who pass ToM
Indefinite NP	1	4
Definite NP	5	6
Pronoun	6	4

Table 1.6– Interlocutor task vs. Theory of Mind

### *Interlocutor Task vs. Linguistic Tasks*

The average scores on the linguistic tasks (gender, case and discourse) were slightly higher in children who used the adult-like phrase (an indefinite noun phrase) in

the interlocutor task than those who used less appropriate forms (a definite noun phrase or a pronoun) in the task. See Table 1.7 for average scores on language tasks in relation to the interlocutor task.

Pronoun type used in Interlocutor Task	Gender Average	Case Average	Discourse Average
<b>Indefinite Noun Phrase</b>	100%	70%	60%
<b>Definite Noun Phrase</b>	93%	56%	57%
<b>Pronoun</b>	93%	67%	48%

Table 1.7 - Language tasks vs. Interlocutor task

### *Theory of Mind and Puppets*

Children who passed the theory of mind task performed better on the tasks involving puppets than the children who failed theory of mind. They had an average score of 69% on the case task (in comparison to 55% for theory of mind failers) and were more likely to use an adult-like introduction in the pronoun task with an average score of 1.0 (in comparison to 0.58 for theory of mind failers). Refer to Table 1.8 for data on theory of mind vs. puppet tasks.

Theory of Mind	Tasks without Puppets		Tasks using Puppets	
	Average Gender	Average Discourse	Average Case	Average Interlocutor Score
<b>Pass</b>	95%	50%	69%	1.0
<b>Fail</b>	93%	58%	55%	0.58

Table 1.8- Theory of Mind vs. Puppet Tasks

### *Spontaneous Pronoun Use*

The children's speech was recorded during the interlocutor task (while playing with a doll in a dollhouse and discussing what the doll was doing in the house). Of the 31 children whose speech was recorded, twenty made no spontaneous pronoun errors, three made spontaneous gender errors (referring to the girl doll as "He"), three made spontaneous case errors (using "Her" in the subject position), and five either used no

subject (“\_\_\_ ate breakfast”) or gave no response regarding the doll. See Table 1.9 for how the children performed overall in spontaneous pronoun use.

Spontaneous Pronoun Use	% of children with no spontaneous pronoun errors	65%
	% of children who made spontaneous gender errors	10%
	% of children who made spontaneous case errors	10%
	% of children who gave no response or used no subject	16%

Table – 1.9 Spontaneous Pronoun Use

### *Children with Incorrect Answers to the Theory of Mind Task Memory Question*

Five children gave incorrect answers to the memory question of the theory of mind task. These children were not counted in the primary data since their theory of mind task response could not have been an informed choice and thus cannot demonstrate their theory of mind ability. These children performed significantly lower on the gender task, a task on which the rest of the participants performed very well. They also performed slightly lower on the case and interlocutor tasks, but had slightly higher scores on the discourse task. See Table 1.10 for the overall results of this subgroup.

Children who missed the Theory of Mind task memory question	Average % on Gender task	57%
	Average % on Case task	56%
	Average % on Discourse Task	63%
	Average of Interlocutor Score	0.6

Table – 1.10 Children failing theory of mind memory question

### *Language Ability Discussion*

As predicted, the findings show that children performed significantly better on the grammatical gender task than on the pragmatic tasks. This demonstrates that receptive gender awareness is one of the earlier acquired skills needed for competent pronoun use. The children also performed slightly better on the grammatical case task than on the two pragmatic tasks, showing that receptive understanding of nominative and accusative case

may also be a earlier developed skill that those of interlocutor specificity and discourse salience. Refer to Table 1.2 for the average scores on all pronoun tasks.

### *Pronouns and Theory of Mind*

This experiment examined the relationship between the different aspects of pronouns and their relation to theory of mind ability. Children who passed the theory of mind task tended to do better on the case task. This result does not necessarily mean that one skill is directly impacting another, but rather that some children may have previously developed all three of the tested abilities. This positive association does not exist between the theory of mind task and the discourse or gender tasks. See Table 1.5 for the average scores on the language tasks in relation to the theory of mind task.

The interlocutor task was also analyzed to determine its possible correlation with the theory of mind task. The results show a small tendency for children who use a more adult-like introduction in the interlocutor task to pass theory of mind. This suggests the need for further investigation to determine whether this association is significant when the number of participants is increased. See Table 1.6 for detailed data on performance on the interlocutor task vs. the theory of mind task.

### *Theory of Mind and Puppets*

Certain tasks in this experiment involved puppets while others did not. The data was analyzed to determine whether or not children's theory of mind ability affects their performance of tasks with puppets more than it affects their performance on non-puppet tasks. The results show that theory of mind ability does not affect the ability to perform well on tasks not involving puppets, but children who passed theory of mind did perform better on the tasks involving puppets. This data illustrates the need to develop a set of

tests that all involve puppets or a set in which puppets are never used in order to better investigate the interrelation of each component of pronouns without the possibility of an interfering factor, such as in this study, the presence or absence of puppets. Refer to Table 1.8 for data on theory of mind vs. puppet tasks.

### *Structured vs. Spontaneous Speech*

The spontaneous speech recorded during the interlocutor task was compared to the pronoun ability shown in the structured tasks of gender and case. Failing the gender or case task is defined as getting less than 4/6 correct on the task. Of the three children who made a spontaneous gender error, all three failed the gender task and of the three children who made a spontaneous case error, all three failed the case task. However, of the twenty children who made no spontaneous pronoun errors, five failed the structured case task and one failed the structured gender task. Therefore, children who make spontaneous errors in pronoun use may illustrate that lack of ability by performing poorly on structured language tasks, but even children who do not demonstrate errors spontaneously may not possess the ability to judge the correctness of case or gender when presented with a structured task. For example, a child may use the correct pronoun case in speech, but not demonstrate the understanding of accusative vs. nominative case if asked to choose which of the two is correct in a given context.

## Section 2.3: Summary and Conclusion

The results of this study demonstrate that children do seem to show a greater understanding of the grammatical aspects of pronouns (gender and case) at an earlier age than they possess knowledge of the pragmatic dimensions of pronouns (discourse

continuity and interlocutor specificity). The main focus of the study was the interaction between theory of mind ability and the different components of pronoun use. While theory of mind ability did not correlate significantly with any of the components of pronoun use, there was a slight correlation between the use of a more adult-like introduction (an indefinite noun phrase) in the interlocutor task and the ability to pass theory of mind. Since there was also a slight increase in performance on the case task with children who passed theory of mind, future research is needed to determine if these slight correlations are significant when the studied population is increased. Another future research implication of this study is the need to examine whether a correlation between multiple aspects of pronoun use and theory of mind is indeed a result of direct correlation, or if there is an outside factor, such as the use of puppets in some tasks but not in others. Overall, future research investigating pronoun use and theory of mind could benefit from a set of tasks that use similar materials (either all puppet tasks or no puppet tasks) as well as a greater number of participants to determine whether there are significant correlations between theory of mind ability and the pragmatic dimensions (specifically interlocutor specificity) of pronoun use.



## Chapter 3: Experiment 2- Children with Autism Spectrum Disorders

### Section 3.1: Method

#### Participants

Thirteen children ranging in ages from 5;8 to 11;8 (12 boys and 1 girl) participated in this study. The average age of this subgroup is greater than that of the typically-developing children because it was important to test children with the attention skills necessary to complete all of the tasks. The children in the study were diagnosed with an autism spectrum disorder by a clinical psychologist. Seven of the children had a clinical diagnosis of Asperger Syndrome, five had a clinical diagnosis of autism, and one had a clinical diagnosis of Pervasive Developmental Disorder. Two of the children were not included in the data below because they were unable to provide answers to all sections of the experiment.

#### Procedures

The same procedure was applied for the five tasks from experiment one (gender, case, discourse continuity, interlocutor specificity, and theory of mind). In addition to the previous tasks, receptive vocabulary was evaluated with the *Peabody Picture Vocabulary Test -III (PPVT -3)* and auditory number memory was evaluated with the Auditory Number Memory-Digits Forward and Auditory Number Memory-Digits Reversed sections of the *Test of Auditory-Perceptual Skills-Revised (TAPS-R)*. The auditory number memory task was added to the procedure for children with ASD because it became apparent while testing the typically-developing children that memory may play a role in some of the tasks, particularly the theory of mind and interlocutor tasks. The

receptive vocabulary was also tested to provide a baseline language measure for the children with ASD since there is great variance of language ability in the particular population and because the chronological age of these children is higher than that of the typically-developing children.

## Section 3.2: Results and Discussion

### *Receptive Vocabulary*

The standard scores of the Peabody Picture Vocabulary Test-3, based on a normal curve with a median of 100, ranged from 47-151 with a mean of 101. Age equivalents were also computed based on the PPVT-3. The results showed that the age equivalents of participants ranged from 2;7 to 22;0, with a mean of 9;1. When the two extreme scores are removed from the calculations, the age equivalent range was reduced to 3;2 to 12;0, with a mean of 8;4. See Table 2.1 for average PPVT results.

Peabody Picture Vocabulary Test (PPVT)	
Average Standard Score	101
Average age equivalent	9;1

Table 2.1: Average PPVT scores

### *Auditory Number Memory*

Overall, the participants performed similarly on both the forward and backward digit recall. On the Auditory Number Memory -Digits Forward task, the standard scores ranged from 73-125, with a mean of 92 and on the Auditory Number Memory -Digits Reversed task, the standard scores ranged from 76-103, with a mean of 88. These standard scores are also based on a normal curve with a mean of 100, for which scores

within one standard deviation from 100 in either direction are considered typical. See Table 2.2 for detailed results on the Auditory Number Memory Task.

Auditory Number Memory - Digits Forward		Auditory Number Memory - Digits Reversed	
Average Standard Score	92	Average Standard Score	88
Min. score	73	Min. score	76
Max. score	125	Max. score	103

Table 2.2: Auditory Number Memory Task

### *Language Ability*

Overall, the participants in this study performed very well on both the gender and case task (with average scores of 91% and 92% respectively). The average score on the discourse task was 68% correct, while the average pronoun score was 1.0, which signifies that the children most often used a definite noun phrase to introduce the subject to a new interlocutor. See Table 2.3 for average scores on each pronoun task.

Average Score	
<b>Gender Task</b>	91% correct
<b>Case Task</b>	92% correct
<b>Discourse Task</b>	68% correct
<b>Interlocutor Task</b>	1.0

Table 2.3: Overall Results on Pronoun Tasks

### *Theory of Mind*

Nine out of eleven children in this study were able to complete the theory of mind task (the other two were excluded from the data due to incorrectly answering the memory question subset of the task. See Study 1 Methods for more detailed information on the memory question). Eight out of the nine children to complete all subsets of the task demonstrated the theory of mind ability to pass an unseen-displacement task. Those who failed the theory of mind task had an average age of 7;4, while those who passed the theory of mind task had an average age of 8;9. See Table 2.4 for theory of mind results.

Theory of Mind	Average Chronological Age	Average Receptive Language Age (PPVT)	Total
Pass	8;11	10;2	8
Fail	8;6	9;5	1

Table 2.4: Theory of Mind results

### *PPVT and Language Tasks*

Children who demonstrated higher receptive vocabulary scores based on the PPVT also tended to perform better on the language tasks (including gender, case, discourse, and interlocutor tasks). See Table 2.5 for detailed results on PPVT scores vs. scores on the language tasks.

PPVT score	Gender Average	Case Average	Discourse Average	Interlocutor Average
High score (> 1 SD above norm)	100%	100%	100%	1.33
Average score (within +/- 1 SD of norm)	100%	100%	63%	1.0
Low score (> 1 SD below norm)	92%	84%	50%	0.5

Table 2.5 -PPVT vs. language tasks

## Section 3.3: Summary and Conclusion

The findings show that the majority of the children with an Autism Spectrum Disorder in the study were able to pass a first order theory of mind task and perform well on the language tasks and that there was a slight correlation between the children's performance on language related tasks and their receptive vocabulary based on the PPVT. This study was carried out to determine whether or not theory of mind may impact pronoun usage, but the findings were not diverse or sufficient enough to show whether or not that is the case. One possible explanation for the results is the broad developmental range of participants chosen for this study. The participants were school-aged with a variety of diagnoses because it was unknown how well the children would be able to

complete the desired tasks. We wanted to select a population that would be capable of completing all the tasks and therefore many of the children were able to pass all of the sections (including theory of mind) without a problem. This supports the findings of Steele, Joseph and Tager-Flusberg (2003) that children with autism spectrum disorders may possess the ability to increase their theory of mind.

It is important to know that although a child was capable of passing the structured language and theory of mind tasks, they did not necessarily demonstrate typical communication behaviors. Behavioral observations during the study and the pre-study period (consisting of talking with the participant and their parent) show that many of the children demonstrated atypical behavior during conversation. Some of these behaviors seemed to suggest a lack of understanding between the child's thoughts and those of their conversation partner; for example: answering questions with very off-topic answers and turning around to face backwards when still addressing the conversation partner with their speech. One mother also commented after the theory of mind task that although their child performed well on that particular task, she feels like her child does demonstrate a difficulty in that area during everyday situations. These research observations suggest that another form of theory of mind task, as well as investigating less structured language tasks may be beneficial for future research in these areas.

The children in the study were able to perform very well on the first-order false belief task without necessary impact on their ability to use pronouns correctly. Based on the previous observations, it would be beneficial to use a second-order theory of mind task in future studies. This would allow more comparisons to be investigated between theory of mind and pronoun usage.

Another future research implication illustrated by this study is the necessity to choose participants with an ASD who are younger than the majority of those in the present study. This should increase the chances of having participants who have not yet developed theory of mind. It is also important to note that the two children who were unable to complete the tasks had an age equivalent of less than 2 years of age (based on the PPVT-3 scores), which may be a good determiner for which subjects may still be too young or low-functioning to successfully participate in the experiment.

Future research could benefit from keeping the previous information in mind when investigating these areas of language and cognition. In order to develop more efficient and effective treatment for the language problems that often accompany an autism spectrum disorder, it is necessary to continue looking at the possible affects of theory of mind on language, including the search for other syntactical/grammatical tasks that may be related to theory of mind ability.

## Chapter 4: References

- Baltaxe, C., & D'Angiola, N. (1996). Referencing skills in children with autism and specific language impairment. *European Journal of Disorders of Communications*, 31, 245-258.
- Baron-Cohen, S. (2000) Theory of mind and autism: a fifteen year review. In S. Baron-Cohen, H. Tager-Flusberg, & D. Cohen (Eds.), *Understanding other minds: Perspectives from developmental cognitive neuroscience*, 2, 3-20. Oxford, UK: Oxford University Press.
- Charest, M., & Leonard, L. (2004). Predicting tense: Finite verb morphology and subject pronouns in the speech of typically-developing children and children with specific language impairment. *Journal of Child Language*, 31, 231-246.
- Dunn, L., & Dunn, L. (1997). The Peabody Picture Vocabulary Test--Third edition. Minnesota: American Guidance Service.
- Gardner, M. (1996). Test of Auditory-Perceptual Skills, Revised. Psychological and Educational Publications, Inc.
- Joseph, R., & Tager-Flusberg, H. (2004). The relationship of theory of mind and executive functions to symptom type and severity in children with autism. *Development and Psychopathology*, 16, 137-155.
- Kamp, H., & Reyle, U. (1993). DRT and predicate logic. In *From discourse to logic: Introduction to model theoretic semantics of natural language, formal logic and Discourse Representation Theory* (Vol. 42, chap. 1). Studies in linguistics and philosophy. London: Kluwer Academic.
- Pratt, A., & Grinstead, J. (2007). *Receptive measures of the optional infinitive stage in child Spanish*. Manuscript submitted for publication, The Ohio State University, Columbus, OH.
- Roberts, C. (2005). Pronouns as definites. In A. Bezuidenhout & M. Reimer (Eds.), *Descriptions and Beyond* (part v, sec. 15 ). Oxford University Press.
- Rowe, A., Bullock, P., Polkey, C., & Morris, R. (2001, March). 'Theory of mind' impairments and their relationship to executive functioning following frontal lobe excisions. *Brain*, 124(3), 600-616. Retrieved February 18, 2007, from Oxford Journals database:  
<http://brain.oxfordjournals.org/cgi/content/abstract/124/3/600>
- Song, H., & Fisher, C. (2005). Who's "she"? Discourse structure influences preschoolers' pronoun interpretation. *Journal of Memory & Language*, 52, 29-57.

- Steele, S., Joseph, R., & Tager-Flusberg, H. (2003, August). Brief report: Development change in theory of mind abilities in children with autism. *Journal of Autism and Developmental Disorders*, 33(4), 461-467.
- Wexler, K., Schutze, C., & Rice, M. (1998). Subject case in children with SLI and unaffected controls: Evidence for the agr/tns omission model. *Language Acquisition*, 7(2-4), 317-344.
- Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining functions of wrong beliefs in young children's understanding of deception. *Cognition*, 13, 103-128.



## Chapter 5: List of Tables

### Experiment One- Typically-Developing Children

Table 1.1- Case Task Example Sentences.....	14
Table 1.2- Overall Language Results.....	18
Table 1.3- Case Results.....	18
Table 1.4- Theory of Mind Results.....	19
Table 1.5- Language Tasks vs. Theory of Mind.....	19
Table 1.6- Interlocutor vs. Theory of Mind.....	19
Table 1.7- Language Tasks vs. Interlocutor Tasks.....	20
Table 1.8- Theory of Mind vs. Puppet Tasks.....	20
Table 1.9- Spontaneous Pronoun Use.....	21
Table 1.10- Children who Failed the Theory of Mind Memory Question.....	21

### Experiment Two- Children with Autism Spectrum Disorders

Table 2.1- Average PPVT scores.....	26
Table 2.2- Auditory Number Memory Scores.....	27
Table 2.3- Overall Language Results.....	27
Table 2.4- Theory of Mind Results.....	28
Table 2.5- PPVT vs. Language Tasks.....	28